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TEST AND EVALUATION OF THE BARE BASE GENERAL PURPOSE SHIPPING A--ETC(U)
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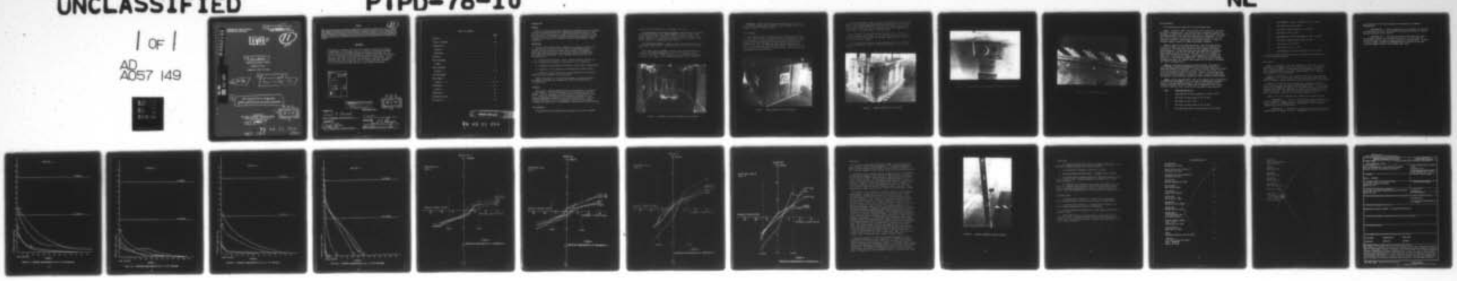

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ABSTRACT

Performance of leakage tests and cyclic exposure tests were requested by WR-ALC/DSP to investigate sources of pressure and moisture problems in Bare Base general purpose shipping and storage containers size "C" and "D". Test results indicated several problem sources were in existence and could contribute to the pressure and moisture difficulties. It was concluded that these containers could provide a watertight environment only when used with extreme care and if no damage had been incurred to the cover structure (specifically to the stacking provision).

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INTRODUCTION

PURPOSE:

This test and evaluation was conducted to determine causes of pressure and moisture problems which have surfaced during operational use. Objectives of this project were to assess the ability of the size "C" and "D" containers in providing a reliable preservation environment during shipping and storing and to determine potential shortcomings of these containers.

BACKGROUND:

The Bare Base general purpose shipping and storage containers size "C" and "D" were procured by the Air Force on development contract F33657-74-C-0571 to be used for Bare Base supplies and equipment. Since their introduction into the inventory, numerous problems have been encountered repeatedly. These problems seem to occur in the following areas:

a. Malfunctioning breather valves creating extensive deformation of the container walls leading to rupturing of a few containers.

b. Accumulation of moisture through water entry and/or condensation.

c. Inability of the containers to efficiently use pallet space.

d. Inability of the containers to provide maximum use of interior space due to the geometry of the containers.

System management for the Bare Base program is located at WR-ALC and support from AFPEA was requested by letter from WR-ALC/DSP on 31 October 1977.

APPROACH

The approach involved indentification of the problem by testing in two major areas. First the integrity of the containers to seal was tested. Both the containers and relief valves were evaluated in this area. Second was the ability of the container to satisfy the performance requirements demanded by the Cyclic Exposure Test presented in MIL-P-116G para 4.4.5.1. The results of these tests were then evaluated to provide data for determining conclusions and recommendations.

TEST EQUIPMENT

To perform the tests requested and detailed in the test procedure

section, the following pieces of equipment were used:

HIGH TEMPERATURE, HIGH HUMIDITY CHAMBER - Manufactured by Standard Environmental Systems, Inc., Model SMTH/960, Serial No. 2815. The chamber operates with a temperature range of +35°F to +200°F $\pm$ 3°F. Chamber humidity is controlled in the range of 20% to 95% RH $\pm$ 5% RH but is limited by a minimum dew point of 45°F.

LOW TEMPERATURE CHAMBER - Manufactured by Tenney Engineering Inc. The chamber operates with a temperature range of -65°F $\pm$ 2°F to +160 °F $\pm$ 2°F.

RAIN, WIND, SALT FOG CHAMBER - Manufactured by Harshaw Chemical Company. The chamber produces rain at 2 $\pm$ 0.5 inches per hour or 5 $\pm$ 1 inches per hour. Temperature control is available from ambient to +130°F. (See Figure 1 for container placement in rain chamber.)

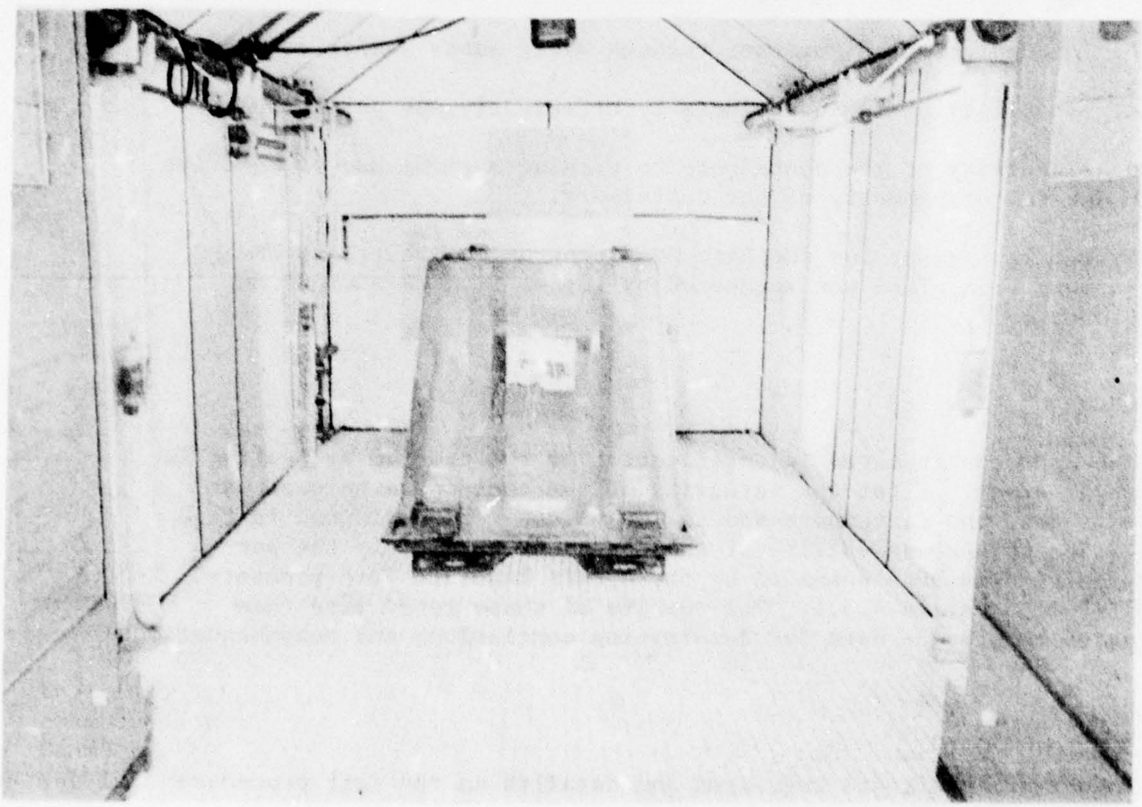

FIGURE 1. PLACEMENT OF SIZE-D CONTAINER IN RAIN CHAMBER

MANOMETER - Manufactured by Meriam Instrument Division of the Scott & Fetzer Company, Model 30EB25 TM, Serial Number L54591, with a range of 60 $\pm$ 0.1 inches of water.

TEST SPECIMENS

Four containers were received for test, two each sizes "C" and "D". When the containers arrived they were given numbers for identification purposes. Both containers No. 1 and 2 were size "D" (see Figure 2) with serial numbers 1015-124D-0140 and 1015-124D-0111 respectively. Size "D" containers have external dimensions of 58 x 41 x 45 inches and weigh 400 pounds empty. The container cover was constructed of fiberglass reinforced plastic while the base was constructed of structural steel.

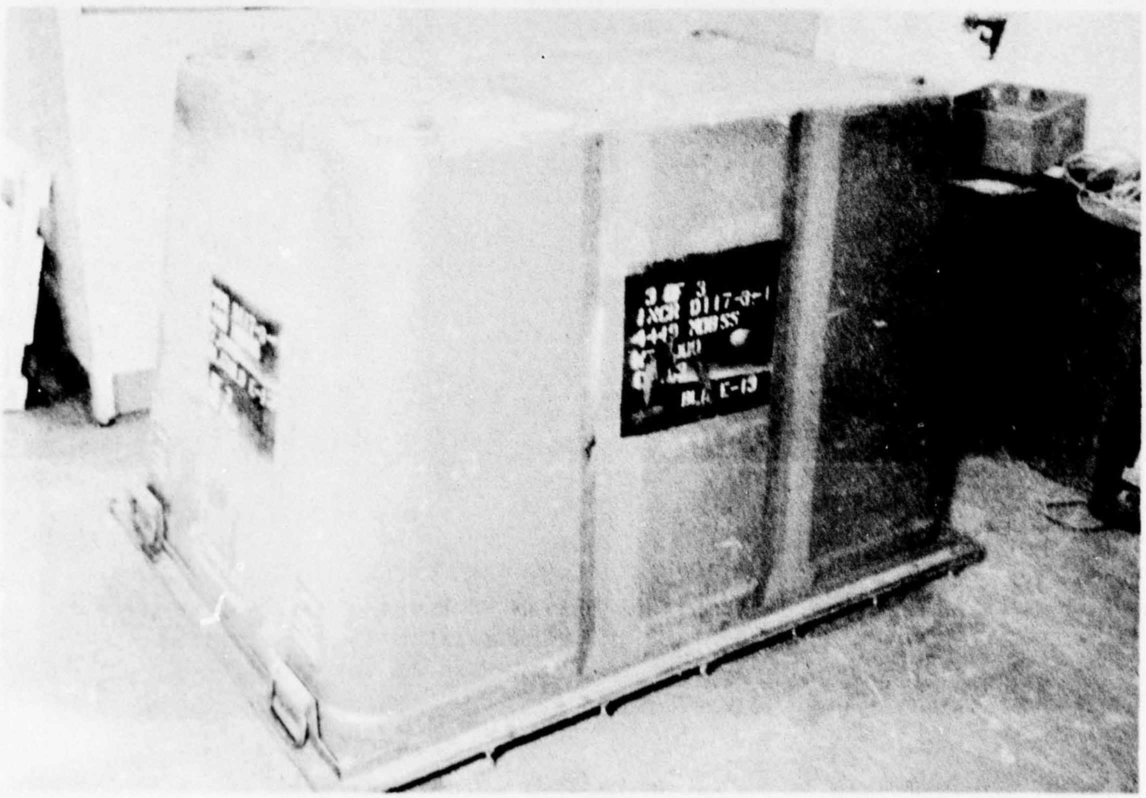

FIGURE 2. GENERAL PURPOSE SIZE-D CONTAINER

Both containers No. 3 and 4 were size "C" (see Figure 3) with Serial Numbers 1015-124C-0453 and 1015-124C-0435 respectively. Size "C" containers have external dimensions of 84 x 58 x 45 inches and weigh 650 pounds empty. Like the size "D" containers, size "C" containers are constructed of fiberglass covers and steel bases.

Each container is furnished with a pressure relief valve and a humidity indicator (see Figure 4). The pressure relief valve operates automatically for both pressure and vacuum conditions with a manual relief button in the center.

Each container arrived with a large quantity of dirt on the gasket and the tops unbolted. Figure 5 indicates the amount of dirt on one gasket.

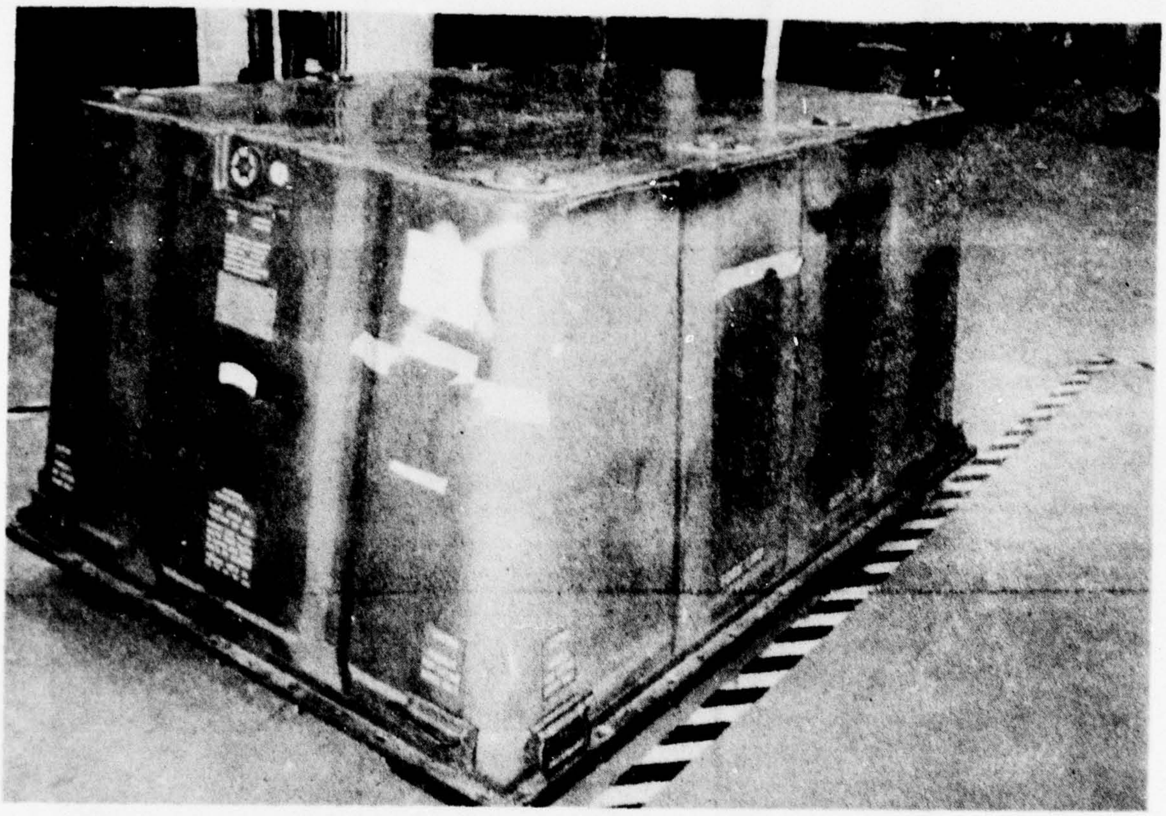

FIGURE 3. GENERAL PURPOSE SIZE-C CONTAINER

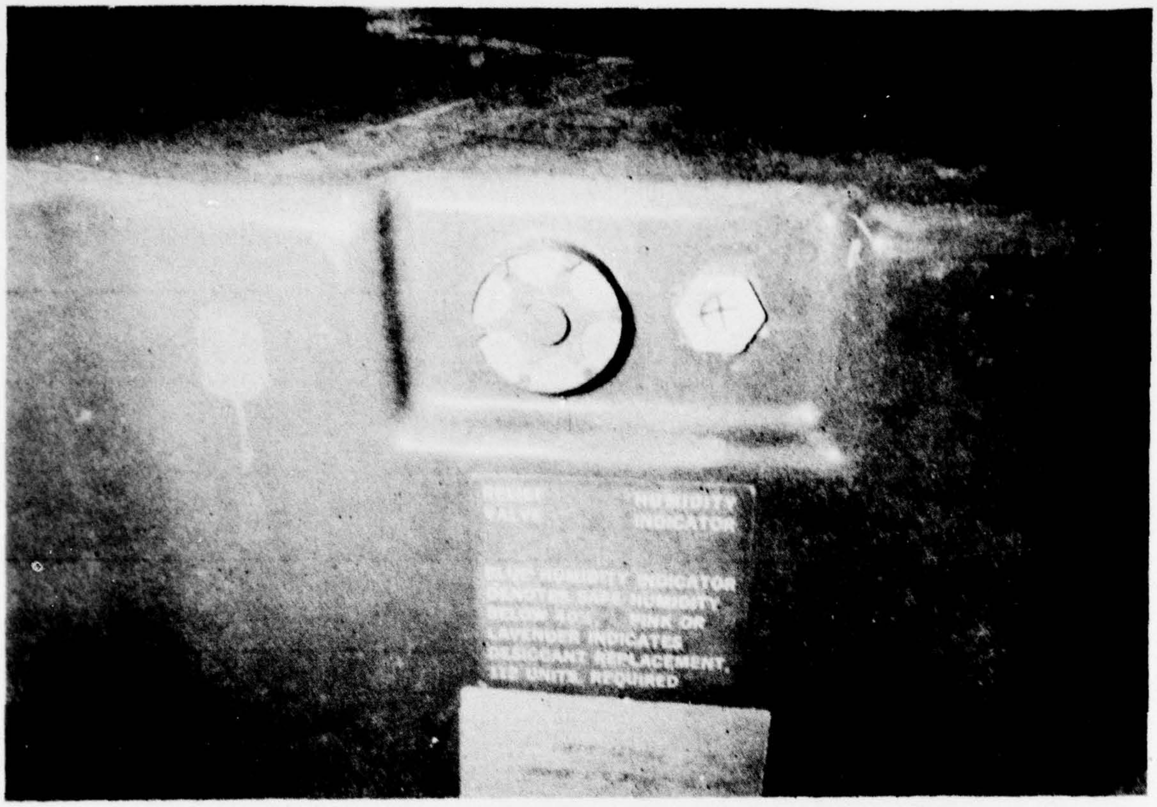

FIGURE 4. PRESSURE RELIEF VALVE AND HUMIDITY INDICATOR CONFIGURATION

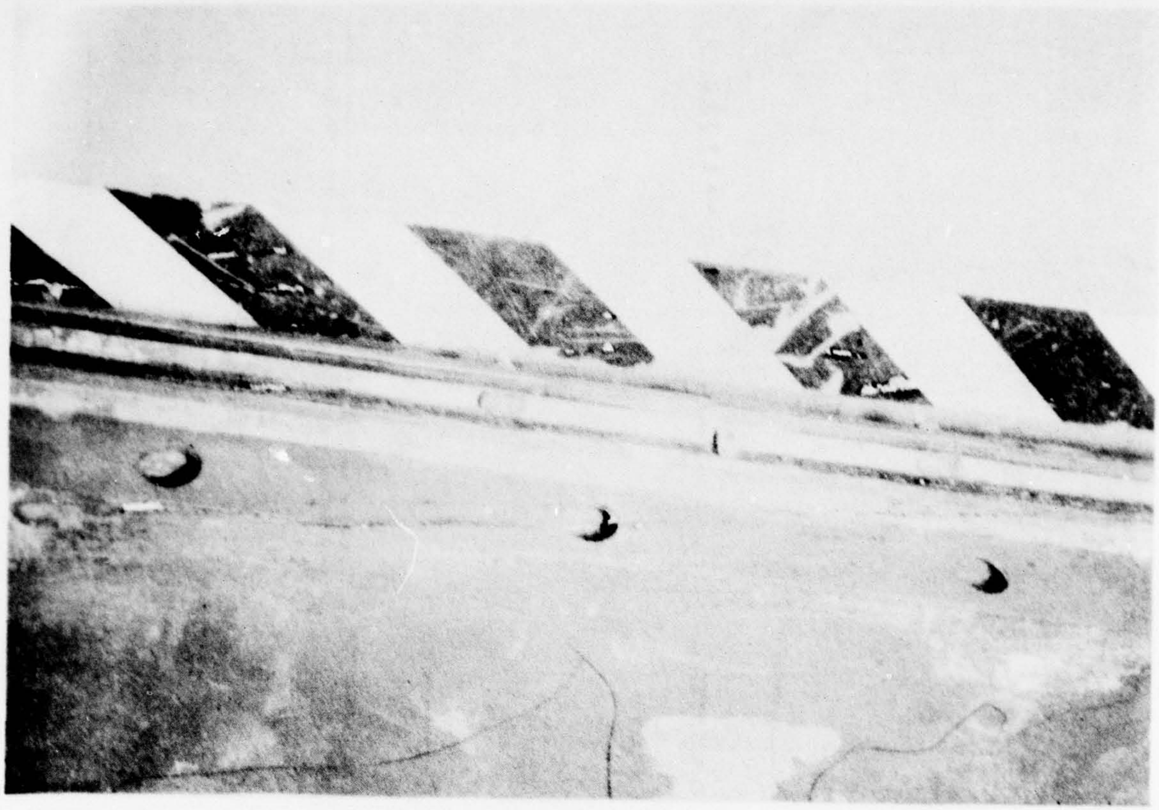

FIGURE 5. GASKET DIRT ACCUMULATION

TEST PROCEDURE

The containers were subjected to the following tests:

TEST-1 (Container Seal) The container with relief valve installed was given a pressure test. The objective was to maintain a sealed environment at differential pressures less than 0.5 psid (pounds per square inch differential). The test was conducted with a manometer. At pressures up to 14 inches of water the air supply was sealed off and the container checked for leaks using a soap bubble solution. Points of interest concern location of leaks and pressure retention.

TEST-1A (Relief Valve Characteristics) Each valve was removed from its container and installed into a sealed drum to examine valve performance. Each valve was checked for both pressure and vacuum characteristics. In each case the valve was subjected to a pressure great enough to cause the air entering (very slow) the container to equal that leaving the container. At this point the air supply was sealed off. The manometer reading taken immediately afterwards was called the relief valve cracking point. From this point on, periodic readings were taken for pressure and elapsed time in order to determine the valves' characteristics.

TEST-1B (Container Deformation Characteristics) The object of this test was to gain some knowledge of the containers ability to withstand pressure differentials. In order to do this, the relief valves were removed from the containers and the valve hole was sealed. The cover was initially torqued to 40 in-lbs. However, further tightening of some bolts was necessary to maintain a seal. Using a straight edge, deformation of each side was recorded for varying pressure differentials.

TEST-2 (Cyclic Exposure Test) The cyclic exposure test as specified in MIL-P-116G, paragraph 4.4.5.1, was used to evaluate the containers ability to protect against moisture. The test was conducted with a slight modification in step 4 (reduction in temperature from a range of 120°F - 130°F to 50°F - 60°F) of the following 14 step sequence:

STEP	CONTAINER SUBJECT TO
1	Approximately 16 hours overnight at 120° to 130°F
2	Two hours of water spray at 50° to 60°F
3	Two hours at -10° to 0°F
4	Two hours of water spray at 50° to 60°F
5	Two additional hours of water spray at 50° to 60°F

6	Approximately 16 hours overnight at 35° to 50°F
7	Four hours at 120° to 130°F
8	Two hours of water spray at 50° to 60°F
9	Two hours at 35° to 50°F
10	Approximately 16 hours overnight at 120° to 130°F
11	Two hours of water spray at 50° to 60°F
12	Two hours at -10° to 0°F
13	Three hours at 35° to 50°F
14	Approximately 16 hours overnight at 120° to 130°F

Sixty-four units of desiccant were installed in each container to absorb the initial moisture.

TEST RESULTS

TEST-1. Containers 1 and 3 were subjected to this test and both indicated that leakage was occurring through the relief valve and at points along the gasket. At this point it was decided to perform Test-1A and Test-1B so that a better understanding of the container characteristics could be achieved.

TEST-1A. Performances of the pressure relief valves are depicted in Figures 6 to 9. In each case, the test set-up was tested with soap bubble solution to assure the only air path was through the relief valve.

TEST-1B. In each case, the container was torqued to 40 in-lbs prior to testing and then further tightening was applied to those bolts near areas of leakage indicated by the soap bubble test. All containers required some additional tightening to slow or stop leakage enough to measure deflection. The containers deformation at the center for each wall is plotted as a function of pressure in Figures 10 to 13.

TEST-2. The cyclic exposure test yielded the following results:

CONTAINER NO. 1 - Only the first two steps were performed as the humidity indicator changed to pink. Opening the container revealed a large quantity of standing water around the gasket. Exact points of moisture entry were not detectable.

CONTAINER NO. 2 - Successfully passed the test with the indicator remaining blue throughout the test. Examination of the open container

upon completion of the test revealed no indications of leakage or condensation.

CONTAINER NO. 3 - After finishing the test sequence the indicator was observed to be pink. The container was opened and found to contain moisture dispersed on the bottom.

CONTAINER NO. 4 - The test was discontinued after step 5 when the humidity indicator was observed to be pink. The container was opened and found to contain a large quantity of standing water. Evidence of water leakage through the stacking devices on the top of the container was found on paper towels draped under them.

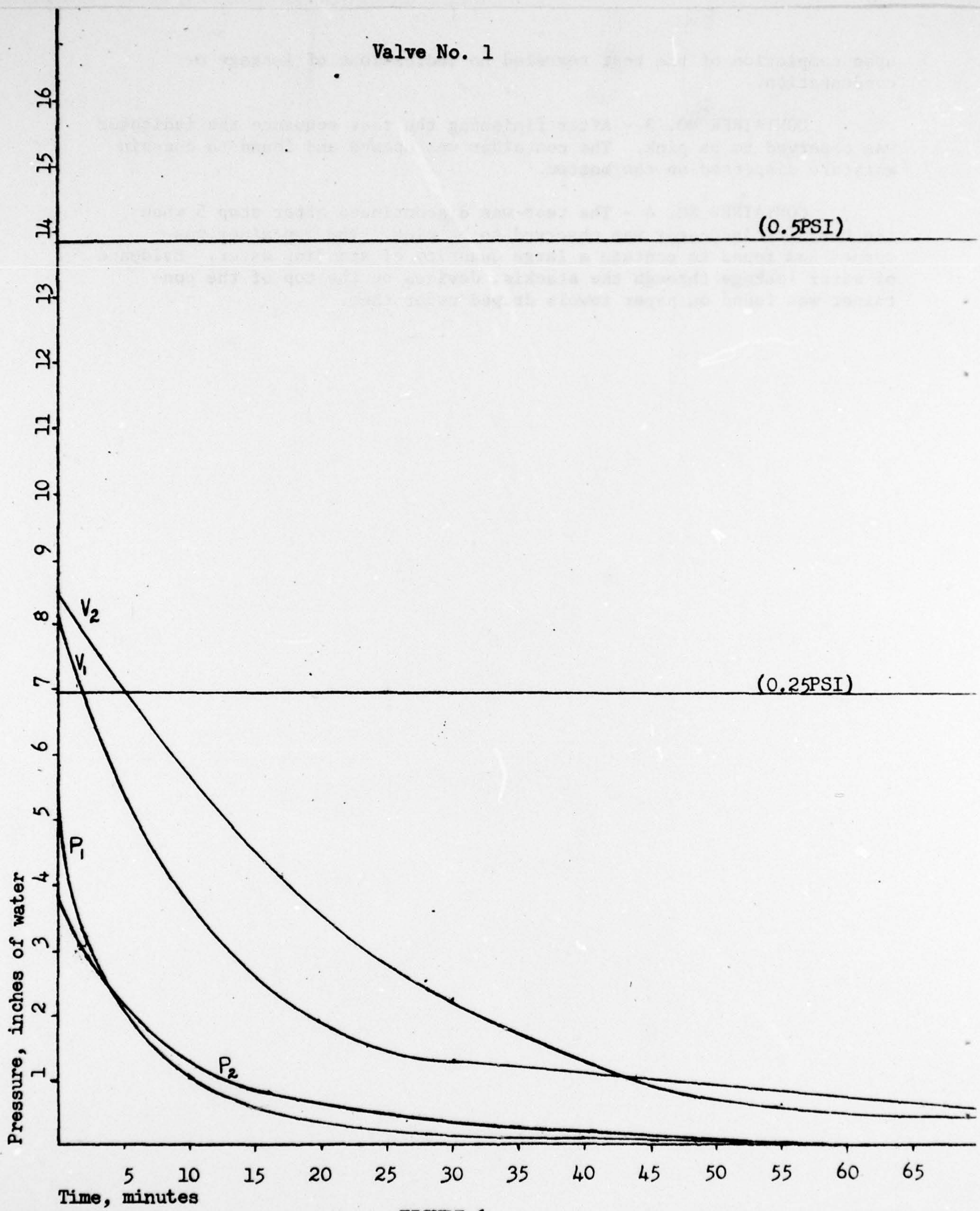

FIGURE 6

VALVE NO. 1 PRESSURE CHARACTERISTICS IN A 1.3 FT^3 CONTAINER

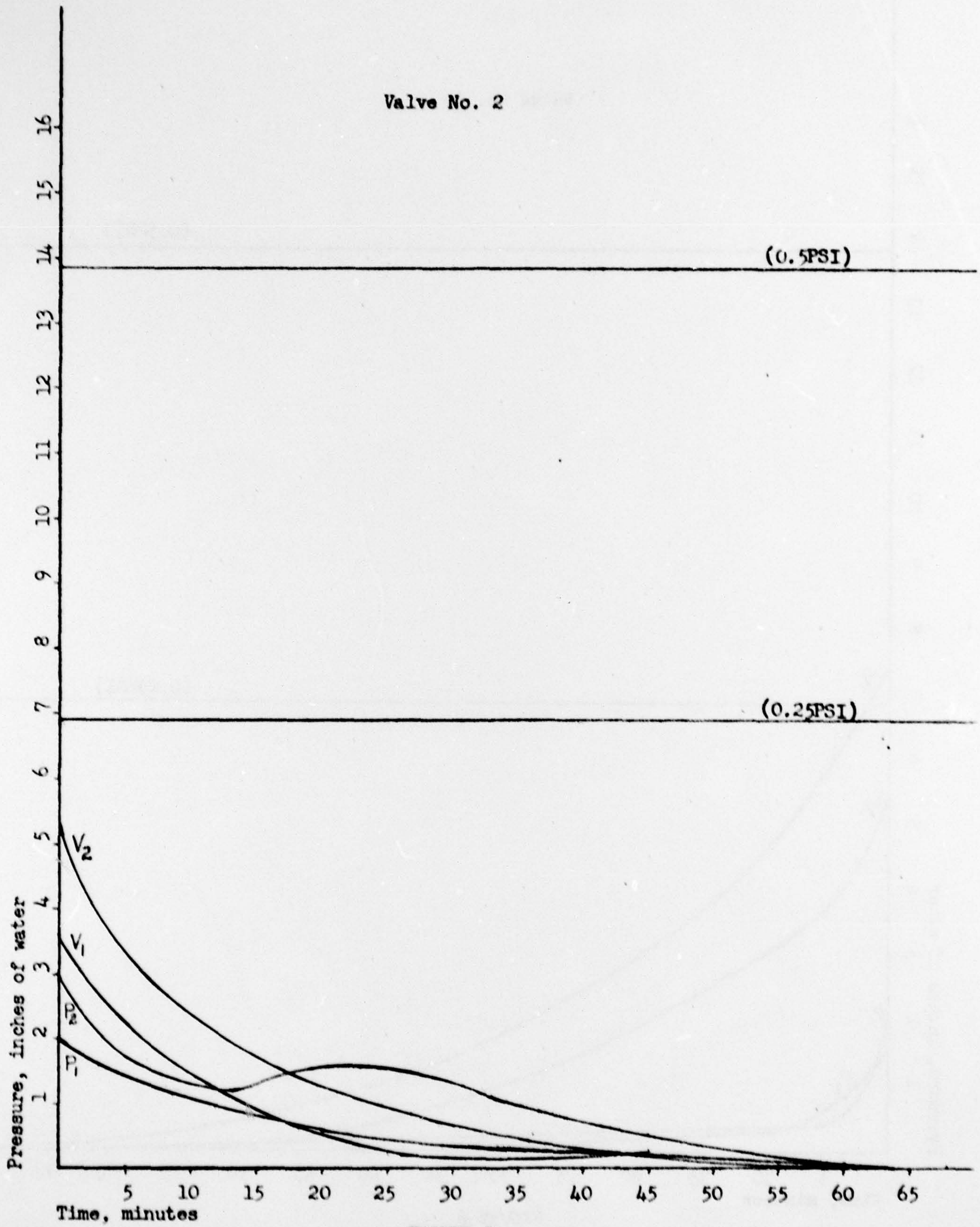

FIGURE 7

VALVE NO. 2 PRESSURE CHARACTERISTICS IN A 1.3 FT^3 CONTAINER

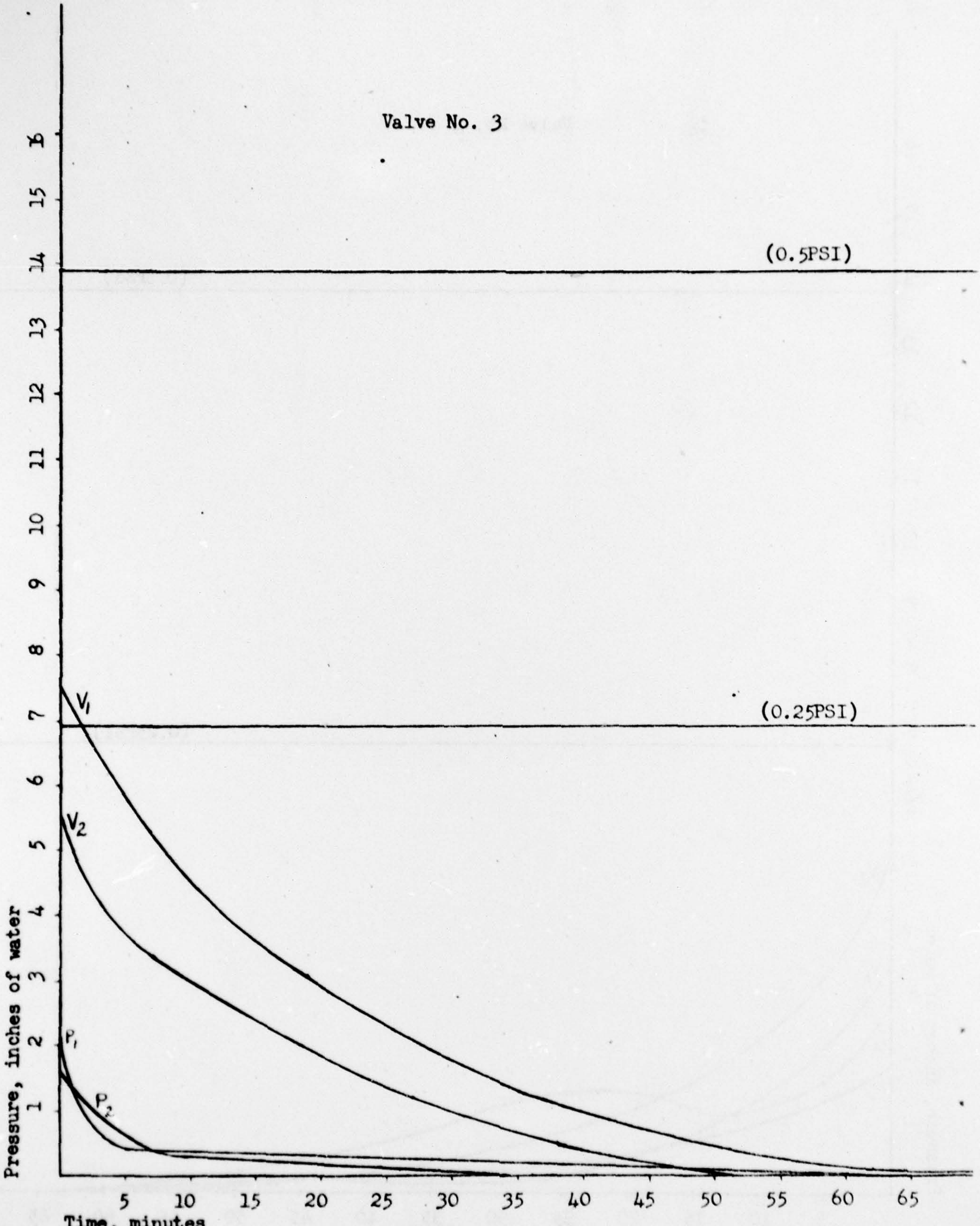

FIGURE 8

VALVE NO. 3 PRESSURE CHARACTERISTICS IN A 1.3 FT^3 CONTAINER

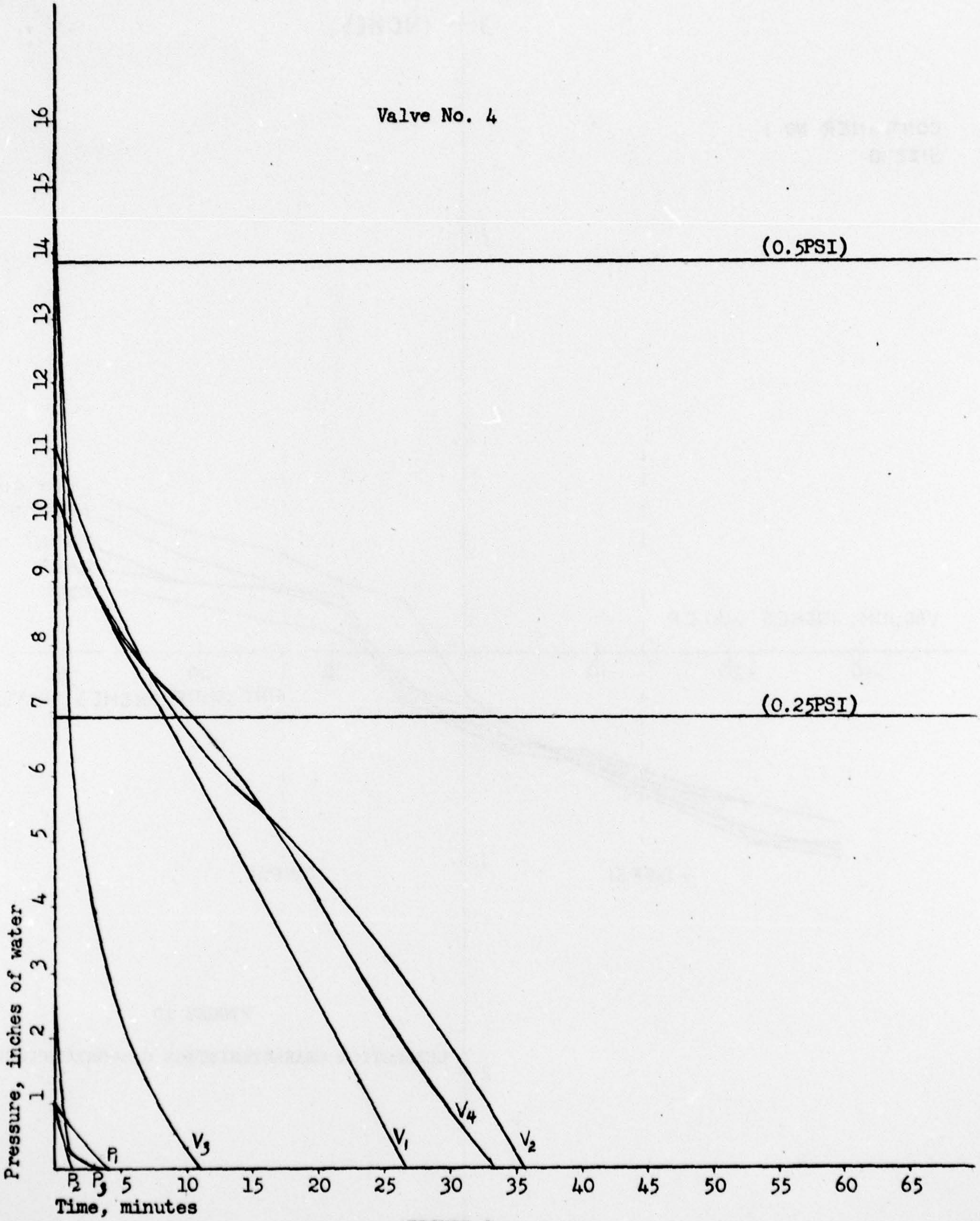

FIGURE 9

VALVE NO. 4 PRESSURE CHARACTERISTICS IN A 1.3 FT^3 CONTAINER

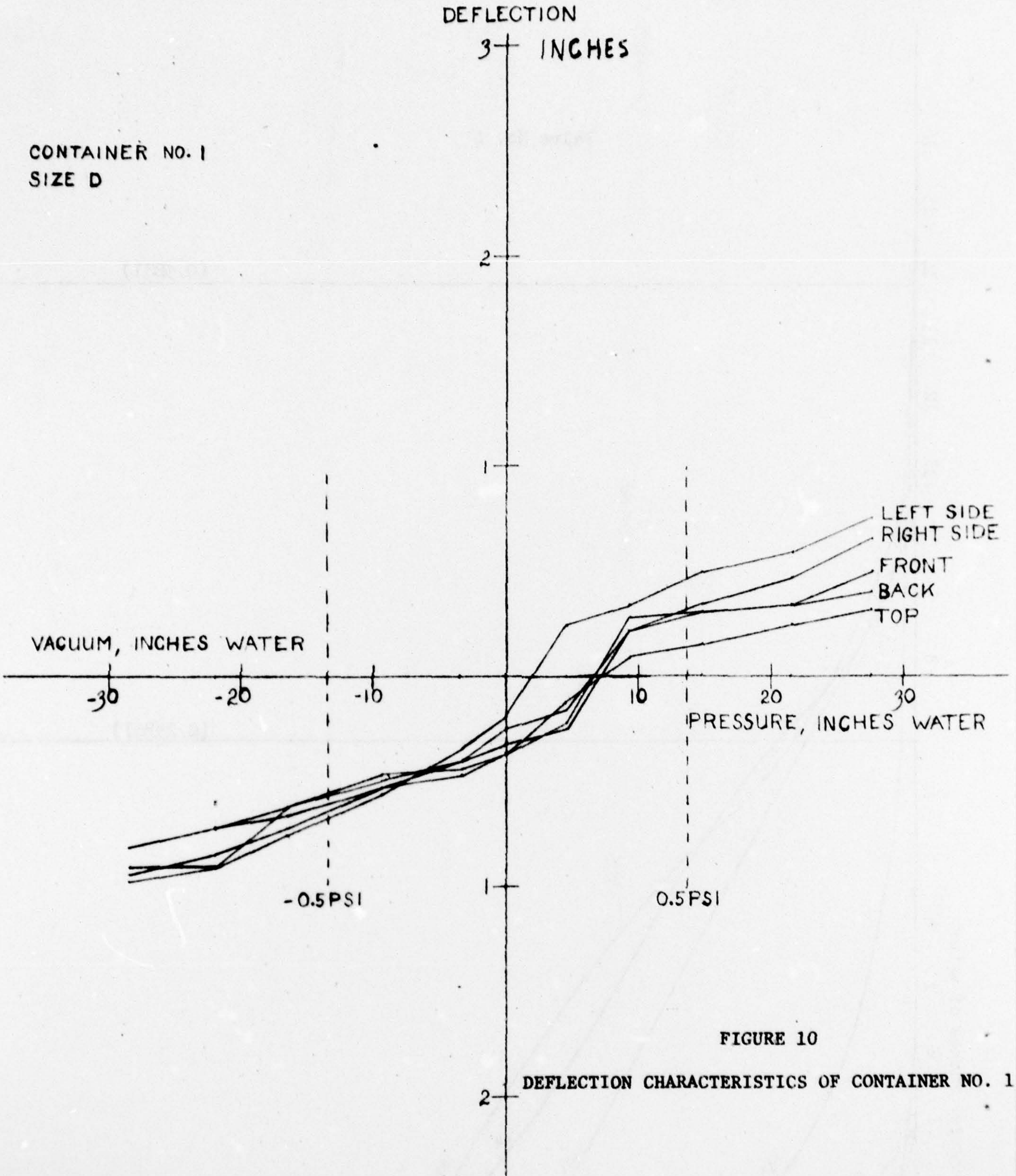

FIGURE 10

DEFLECTION CHARACTERISTICS OF CONTAINER NO. 1

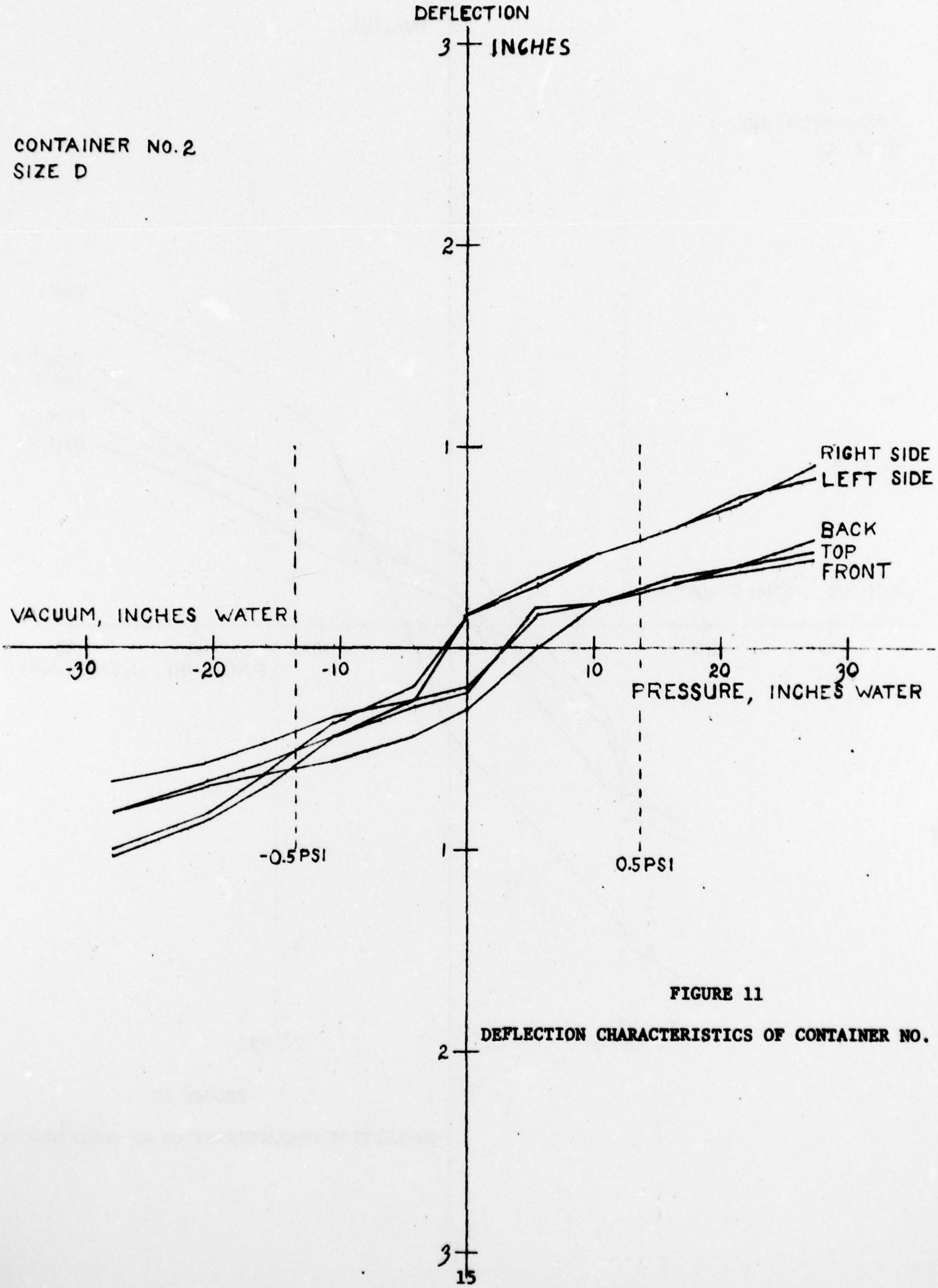

FIGURE 11

DEFLECTION CHARACTERISTICS OF CONTAINER NO. 2

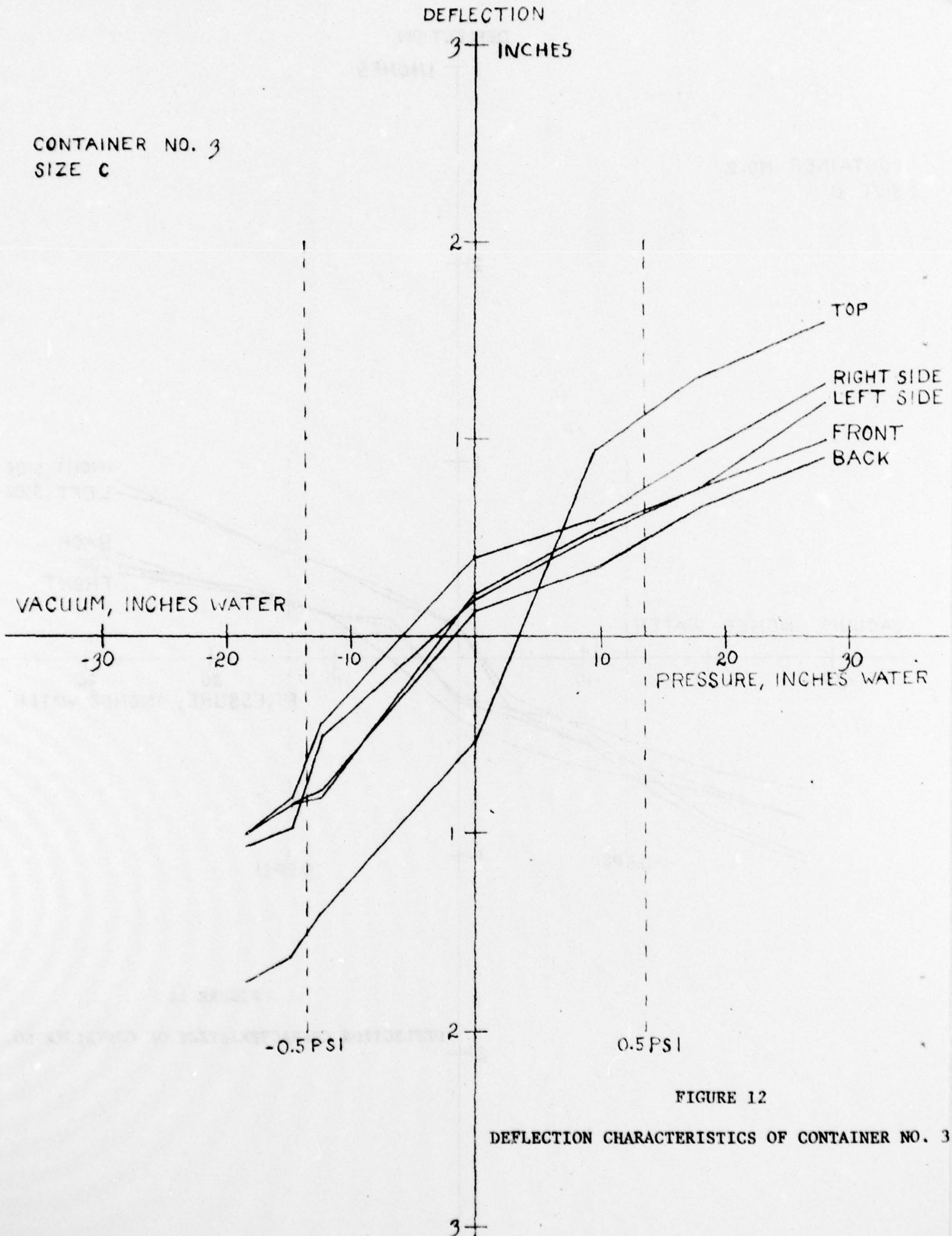

FIGURE 12

DEFLECTION CHARACTERISTICS OF CONTAINER NO. 3

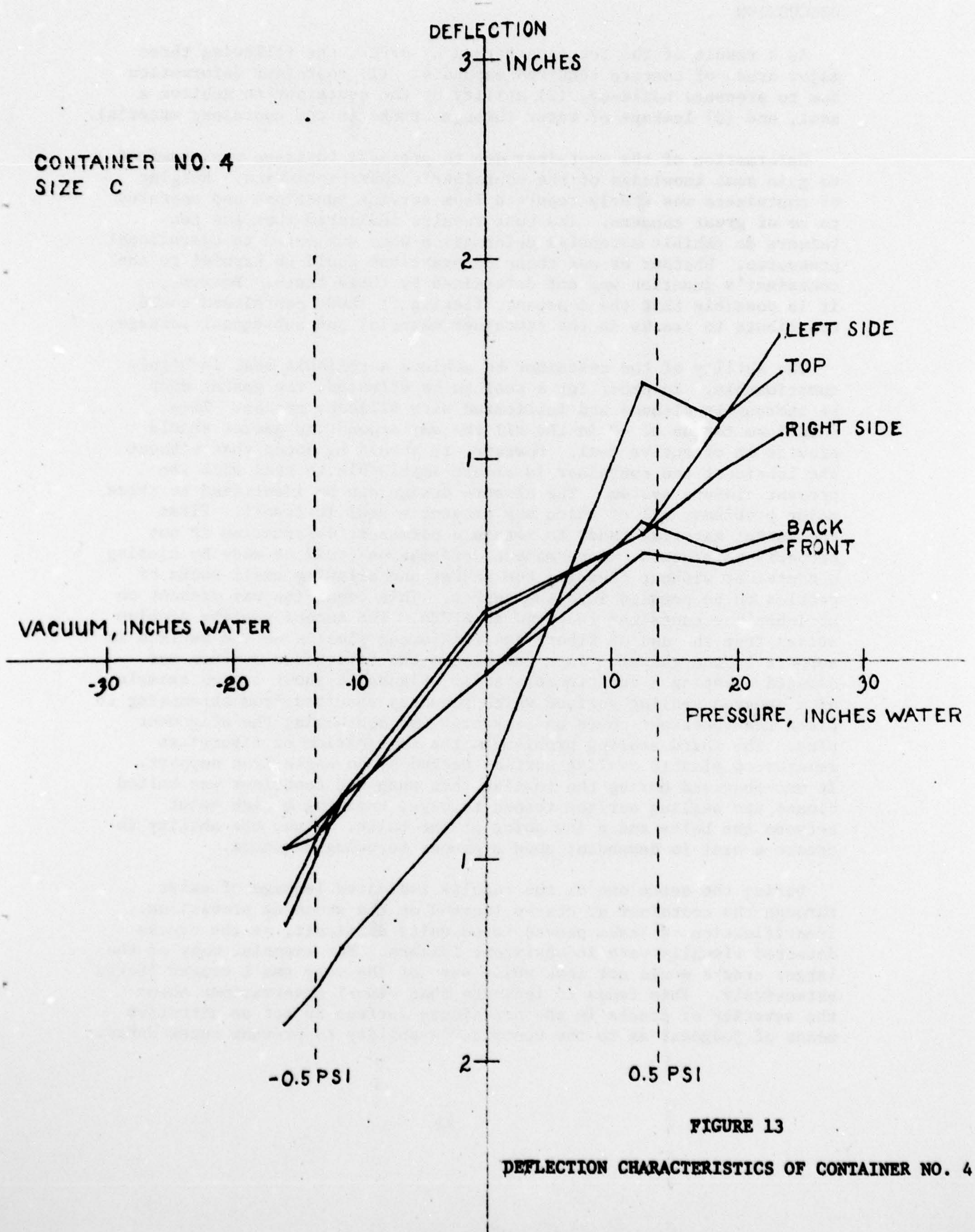

FIGURE 13

DEFLECTION CHARACTERISTICS OF CONTAINER NO. 4

DISCUSSION

As a result of the tests performed by AFPEA, the following three major areas of concern required emphasis: (1) container deformation due to pressure build-up, (2) ability of the container to achieve a seal, and (3) leakage of water through cracks in the container material.

Deformation of the container due to pressure build-up was examined to gain some knowledge of the container's characteristics. Bulging of containers was widely reported from service functions and appeared to be of great concern. The test results indicated that the containers do exhibit extensive deformation when subjected to operational pressures. Whether or not these deformations could be harmful to the container's function was not determined by these tests. However, it is possible that the constant flexing of these containers could contribute to cracks in the container material and subsequent leakage.

The ability of the container to achieve a reliable seal is highly questionable. In order for a seal to be effected, the gasket must be thoroughly cleaned and lubricated with silicone grease. Then a uniform torque of 40 in-lbs all the way around the gasket should provide an effective seal. However, it should be noted that without the lubricant the container is almost impossible to seal with the present closure system. The closure design can be identified to three major problems, all of which may prevent a seal in itself. First the gasket material tends to retain a permanent deformation if not properly maintained. A permanent deformation could be made by closing a container without cleaning the gasket and allowing small rocks or pebbles to be pressed into the gasket. This condition was present on at least one container received at AFPEA. The second sealing problem arises from the use of fiberglass reinforced plastic as the surface in support of the gasket. In a few places the fiberglass surface was damaged creating a questionable seal. Figure 14 shows a good example of a damaged sealing surface which possibly resulted from attempting to place the container cover on backwards and contacting the alignment pins. The third sealing problem is the combination of fiberglass reinforced plastic sealing surface backed by an angle iron support. It was observed during the testing that when the container was bolted closed its sealing surface tended to wave, creating a high point between the bolts and a low point at the bolts. Thus, the ability to create a seal is dependent upon a proper torquing sequence.

During the tests one of the results indicated leakage of water through the container at cracks located on the stacking provisions. Identification of leaks proved to be quite difficult, as the cracks detected visually were inconsistent leakers. For example, many of the larger cracks would not leak while some of the very small cracks leaked extensively. This tends to indicate that visual observations about the severity of cracks in the containers surface is not an effective means of judgment as to the container's ability to prevent water entry.

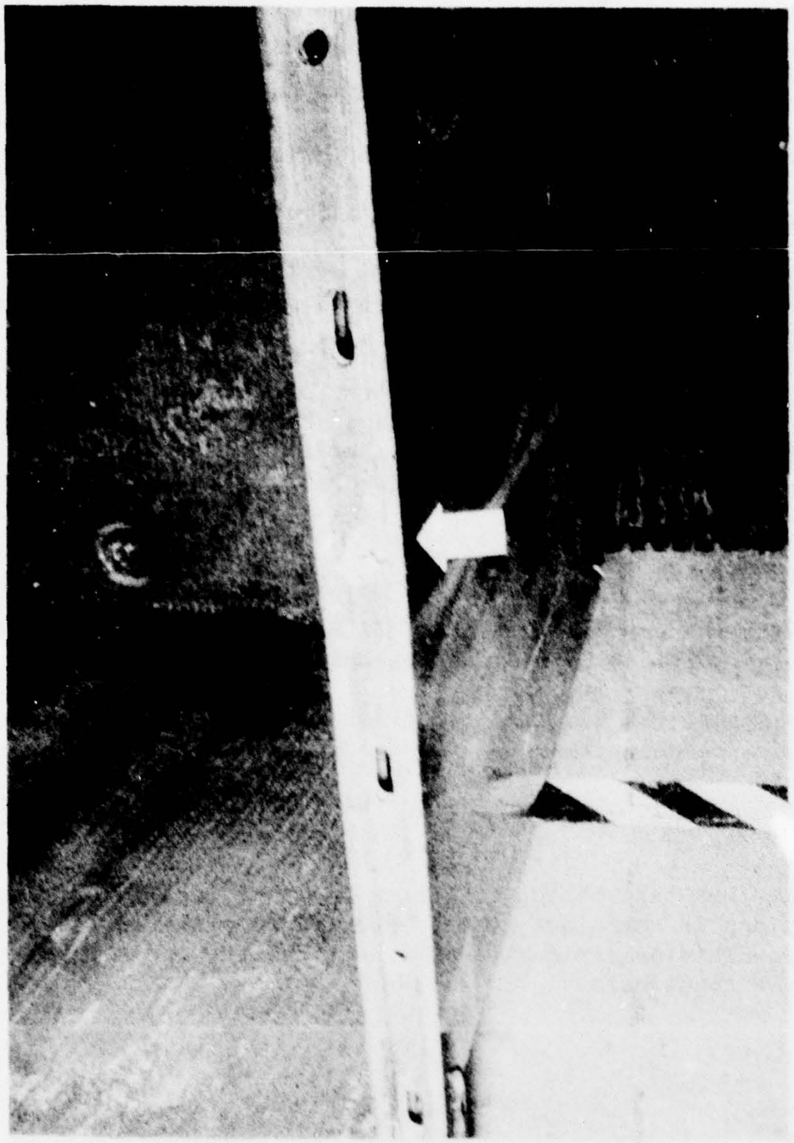

FIGURE 14. CHIPPED FIBERGLASS SEALING SURFACE

CONCLUSIONS

1. The containers tested each bulge at pressures less than 0.5 psid. Deformation range up to one inch in each direction.

2. At 40 in-lbs the container is difficult to seal.

3. Damaged stacking provisions were a frequent source of leaks.

4. The relief valves performed differently and each leaked pressure over a period of time. Leakage appeared to be slight for the large volume container.

5. The containers will provide a watertight environment if sealed with care. However, the greater the usage the more material damage will be experienced contributing to leakage. When this occurs, the container must be repaired before it can satisfy the intended function.

RECOMMENDATIONS

1. Investigate the feasibility of filling in the undersides of the stacking provisions to prevent leakage due to stacking damage.

2. Investigate the feasibility of making these containers into free breathers reducing side and top deformations.

3. Place an additional marking on the cover indicating location of alignment holes.

4. WR-ALC/DSP take action to determine if pallet space is used efficiently and if container geometry restricts proper usage of container cube. This determination must consider the items intended to be used in these containers.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Performance of leakage tests and cyclic exposure tests were requested by WR-ALC/DSP to investigate sources of pressure and moisture problems in Bare Base general purpose shipping and storage containers size "C" and "D". Test results indicated several problem sources were in existence and could contribute to the pressure and moisture difficulties. It was concluded that these containers could provide a watertight environment only when used with extreme care and if no damage had been incurred to the cover structure (specifically to the stacking provision).

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